Most of the ternary operators which in recent investigations have had their importance established, do not involve first derivatives. They are the results of replacing first derivatives by zeroes in operators such as above, or may be regarded as linear functions of different operators. The transformation of the various annihilators of pure and projective cyclicants is considered from the latter point of view.

It is indicated, however, without much development that, if preferred, it is possible to consider the transformation of operators free from first derivatives without use of operators in which those derivatives occur. In illustration of the method it is established that, if $[\mu, \nu, \nu'; m, n, n']$ denote that part of $\{\mu, \nu, \nu'; m, n, n'\}$ which is free from first derivatives,

$$(x_{10}x_{01})^{\frac{1}{2}(1-m)}[-m, 1, 1; m, 0, 0]_x = (y_{10}y_{01})^{\frac{1}{2}(1-m)}[-m, 1, 1; m, 0, 0]_y$$
$$= (z_{10}z_{01})^{\frac{1}{2}(1-m)}[-m, 1, 1; m, 0, 0]_z$$

gives for different values of m a class of cyclically persistent operators.

XIII. "On the Rate of Decomposition of Chlorine-water by Light." By G. Gore, LL.D., F.R.S. Received June 13, 1889.

(Abstract.)

In this research, the author has investigated by means of the voltaic balance the kind and amount of chemical change, the rate at which decomposition proceeds, and the chemical composition of the products formed at all stages of decomposition of chlorine-water, when exposed to daylight and sunlight in colourless glass vessels.

The chlorine-water, by exposure to diffused daylight, was decomposed with moderate uniformity, but at a gradually diminishing rate, as shown by the losses of voltaic energy, until no further loss of such energy occurred; the liquid then consisted of an aqueous solution of hydrochloric acid, hypochlorous acid, and chloric acid. By further exposure of the liquid to daylight and sunlight during several weeks, peroxide of hydrogen was formed; and the amount of hydrochloric acid and of voltaic energy very slowly increased until that of the latter became about equal to that of dilute hydrochloric acid of equivalent strength to the whole of the chlorine present; all the other chief properties of the final liquid agreed with those of a mixture of dilute hydrochloric acid and peroxide of hydrogen. Still further exposure to strong sunlight caused no further change in chemical composition, amount of voltaic energy, or other property of the liquid.

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This research shows distinctly that the decomposition of chlorine-water by light may be divided into two essentially different parts or periods of chemical change, and that the kinds of chemical change occurring during these two periods are largely different. During the first period, a very great and gradual *loss* of voltaic energy occurs, attended by formation of hydrochloric, hypochlorous, and chloric acids. During the second period, a moderate and very slow *increase* of voltaic energy takes place, accompanied by decomposition of the hypochlorous and chloric acids, a further formation of hydrochloric acid, and the production of peroxide of hydrogen. Under the influence of prolonged sunlight, the whole of the oxygen of the hypochlorous and chloric acids united with water to form peroxide of hydrogen, and the peroxide then combined with the whole of the hydrochloric acid to form a definite "solution compound" represented by the formula $2HCl,H^2O^2$.

The chemical composition of the products of the change at the ends of the first and second periods of change was ascertained by means of the voltaic balance and ordinary chemical analysis. During the first period forty consecutive measurements of the voltaic energy at stated intervals of time were made, and the energy diminished from about 1219 millions to 2·9 millions; and during the second period eight such measurements were made, and the energy increased to 9·3 millions. A curve is given showing the rate of loss of energy during the first period.

It is interesting to observe, that suitably decomposed chlorine-water, or, in its stead, a mixture of $6HCl + HClO + HClO^3$ dissolved in a proper proportion of water, has the property of absorbing energy by exposure to light, very much like that possessed by the green leaves of plants.

XIV. "Barium Sulphate as a Cement in Sandstone." By FRANK CLOWES, D.Sc., Principal and Professor of Chemistry and Metallurgy in University College, Nottingham. Communicated by Professor ARMSTRONG, F.R.S. Received June 6, 1889.

About six miles west of Nottingham there are two prominent conical sandstone hills which are so different in appearance from any surrounding elevations of the surface as to arrest attention. These are known as Stapleford Hill and Bramcote Hill. In the gap between them stands a remarkable sandstone pillar, some 30 feet in height, and 70 feet in circumference, and distinctly crowned by a flattened mushroom-shaped cap. This is locally known as the Hemlock Stone. The sandstone beds forming these hills and columns have been classed